

RESTRICTED CIRCULATION

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Agricultural Memorandum no. 825

Ontario Unit Map of Britain

In studies which relate plant development and weather air temperature has often been used. A common technique has been to use accumulated temperature above some base temperature with the hope that the accumulated temperature sums are constant between phenological events. This technique assumes that plant development rate varies linearly with temperature, which is only true for relatively small temperature ranges. A refinement to the simple linear response is to assume that plant development rate varies parabolically with air temperature above some base at which development is zero. The so-called "Ontario Unit" is an example of the latter system. It was originally developed for soya beans and was then applied to maize, and possibly could also be applied to other tropical crops being grown in a temperate environment such as sunflowers and outdoor tomatoes.

The Ontario Unit consists of a day and a night term.

$$\text{Day term } Y = 3.33 (T_{\text{MAX}} - 10) - 0.084 (T_{\text{MAX}} - 10)^2$$

$$\text{Night term } X = 1.8 (T_{\text{MIN}} - 4.4)$$

T_{MAX} is the day maximum air temperature $^{\circ}\text{C}$

T_{MIN} is the night minimum air temperature $^{\circ}\text{C}$

The day term has a base of 10°C and represents a near linear variation between 10 and 20°C , but with a steady decrease above 20°C with Y reaching a maximum value at 32°C .

The night term is linear above a base of 4.4°C .

$$\text{The Ontario Unit, } OU = (Y + X)/2.$$

The justification for these formulae is not easy to find in the literature, but the day term would appear to represent the effects of temperature on maize photosynthesis and the night term could be a crude representation of how temperature affects respiration.

The calculation of OU can be done using daily maximum and minimum temperature and this was done using the MAD tapes for 33 UK stations. Monthly mean maximum and minimum temperatures can also be used to find Y and X . The monthly values obtained by multiplying by the number of days in the month are very close to monthly values obtained by summing daily contributions.

Regression equations were evaluated for the 33 stations for which daily Ontario Units were calculated. These regressions were of the form

$$OU = a T - b$$

where, OU is the sum of daily Ontario Units from May to October.

T is the sum of the six monthly mean temperatures ($^{\circ}\text{C}$) from May to October.

The correlation between OU and T was above 0.98 for all the stations. The values of the coefficients a and b varied in a systematic way across the country.

	West Coast	Midlands	East Coast
a	60.5	52.5	56.5
b	2290	1610	1950

By using this table with values of T obtained from Technical Bulletin 35, together with OU values from the 33 stations it was possible to draw an Ontario Unit map for Britain.

Map of Average Ontario Units (May to October)

The data from Technical Bulletin 35 give mean temperatures for the period 1941-70 whereas the daily data from the MAD tapes was for the period 1957-75. The two sets of data generally agreed quite well.

Values exceed 2900 in south east Essex, north Kent, south Hampshire, Isle of Wight, small parts of Avon, Somerset and Devon, and the Channel Islands. Favourable localities in these areas could reach 3000 units. Much of the English Midlands has between 2500 and 2700 with two favoured areas further north: Cheshire and the area to the east of the Pennines where North, West and South Yorkshire meet. In Scotland, small areas of the Central Lowlands and the area around Perth receive 2300 units, though much of the country is below 2100. In northern Ireland the 2300 unit isopleth is found in county Armagh with values below this over the rest of the area.

Application of the Map to Determine Suitable Areas for Maize and Sweet Corn

Experimental work has shown that the following values of Ontario Units are a reasonable guide to phenology for sites where purely local influences on air temperature are not predominant.

<u>Crop Stages</u>	<u>Ontario Units</u>	<u>°C days above 10°C</u>
Sowing - silking	1400	400
Sowing - 25% whole crop dry matter. (Clamp silage, earliest sweet corn CV's suitable for picking)	2300	600
Sowing - 50% whole crop dry matter (Tower silage, most early sweet corn CV's suitable for picking)	2500	700
Sowing - grain moisture content of 40%. (Suitable for combining for grain)	2700	800

These are the minimum values which are required to achieve these stages. If the crop is to be worth growing in an area, then these values will have to be exceeded for as many years as is considered economically viable. Statistically this means the specification of the probability of exceeding these values. Ontario Units are

approximately distributed normally about the mean with a standard deviation close to 208 OU over much of the country. If, for example, we want to exceed 2500 OU in 90% of seasons then the average number of units a place must have to achieve this is $2500 + (1.29 \times 208)$.

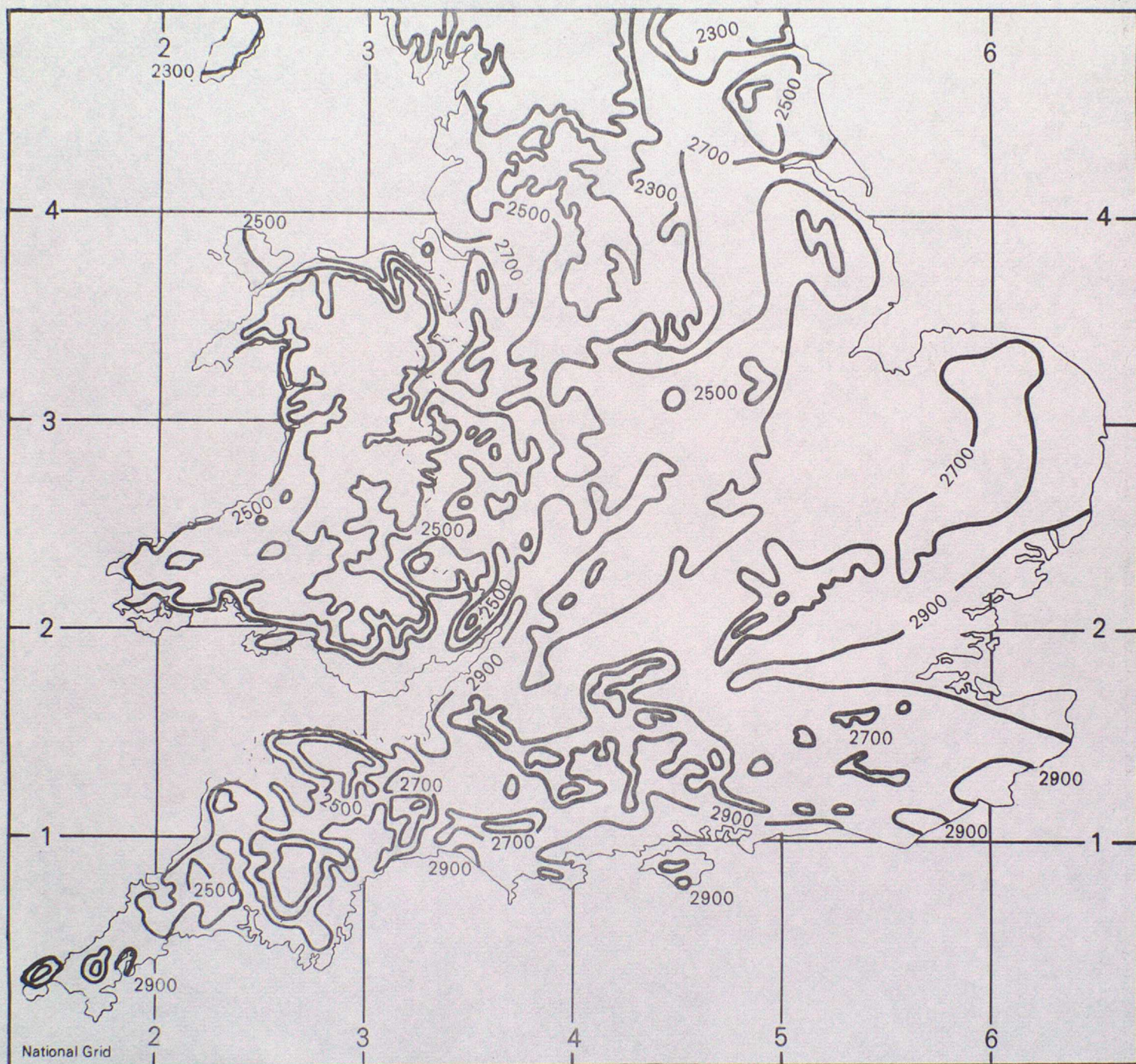
The map in figure 2 shows the areas which exceed 2300 and 2500 for at least 9 years in 10 and so represents the areas where silage maize and sweet corn should have the greatest success. Nevertheless, even in the areas shown as favourable careful attention should be made to field selection when growing maize, and cold or exposed situations should be avoided. Maize grown for grain should be restricted to the most favourable areas of Hampshire, Sussex, Kent and Essex.

The remaining maps show the numbers of years out of ten that particular OU totals are exceeded in the Agro Climatic Areas. For each area three numbers are given. The top one in each area refers to the lowest altitudes, the middle number to average area height and the bottom number to the highest parts of each area. This therefore is a supplement to Technical Bulletin 35 and the maps can only be used with that publication.

Any comments or criticisms should be sent direct to the author.

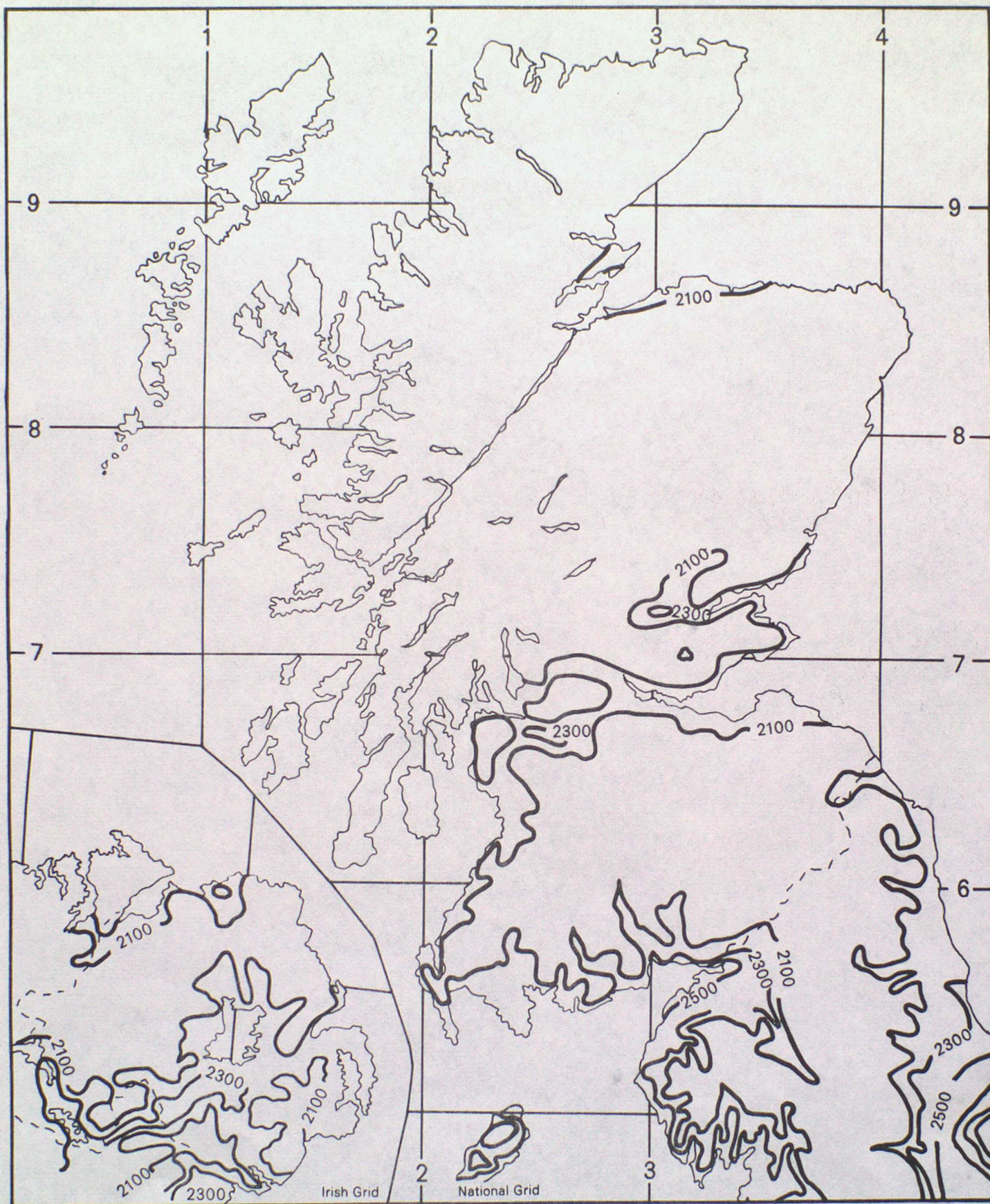
M N Hough

Meteorological Office
February 1978



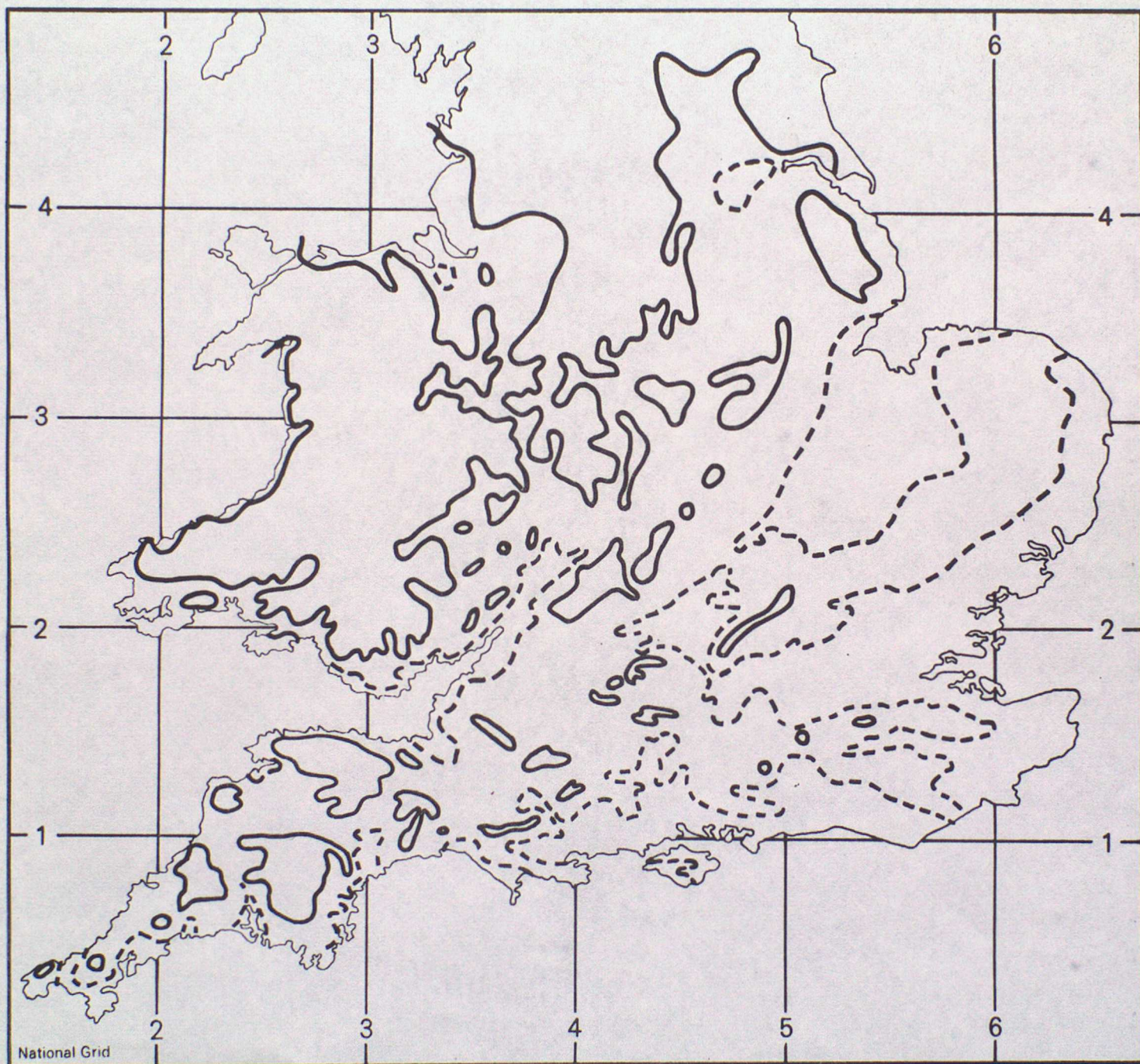
Great Britain Average Ontario Units (May-Oct)

Isopleths at:- 2300 2500 2700 2900



Great Britain Average Ontario Units (May-Oct)

Isopleths at:- 2100 2300 2500 2700 2900



Areas which exceed the following number of o.u. for 9 years in 10:-



2300 o.u.



2500 o.u.

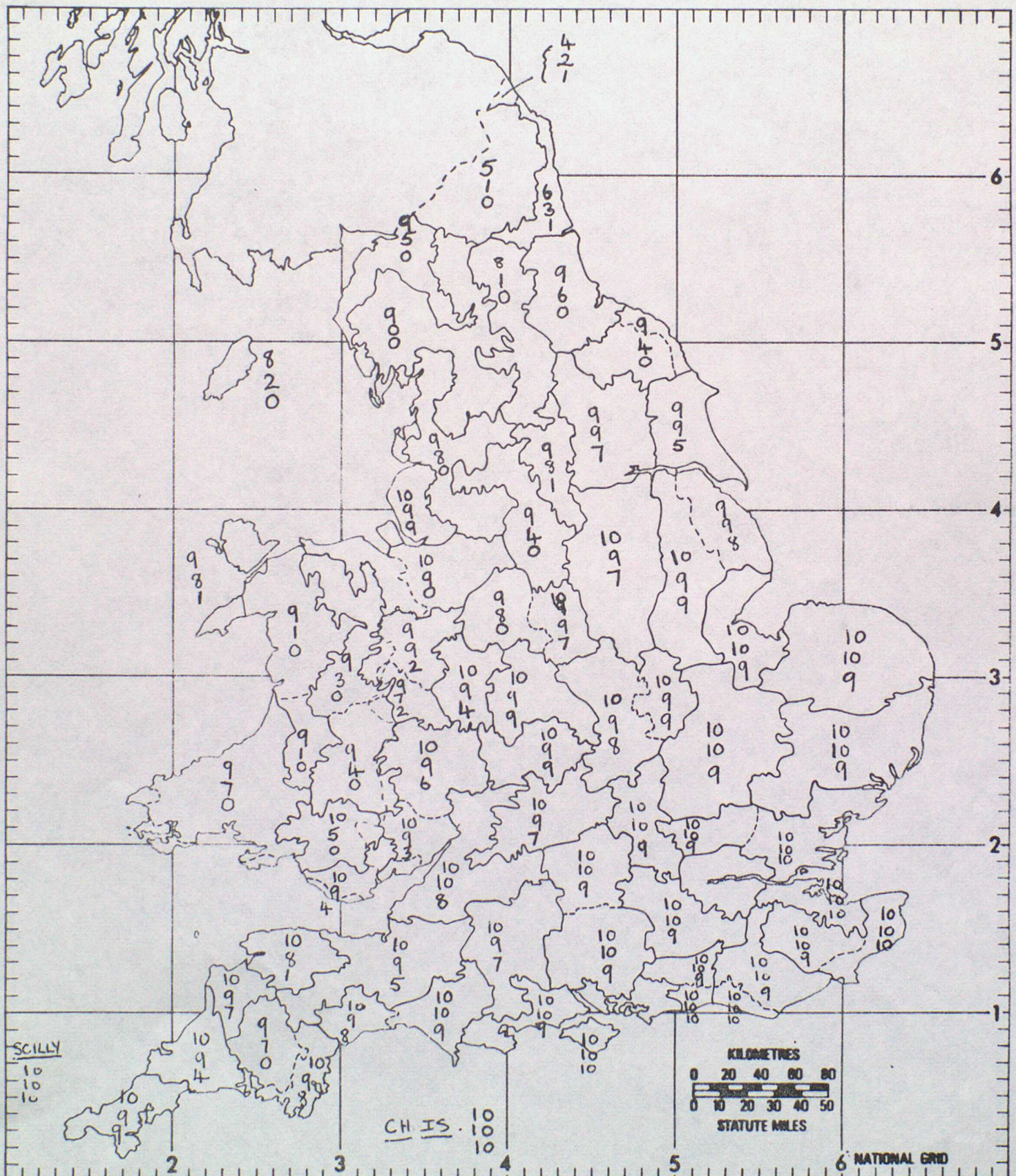
LOW HEIGHT.

2300

AVERAGE HEIGHT.

HIGH HEIGHT.

YEARS IN 10 >.



AGROCLIMATIC AREAS FOR ENGLAND AND WALES

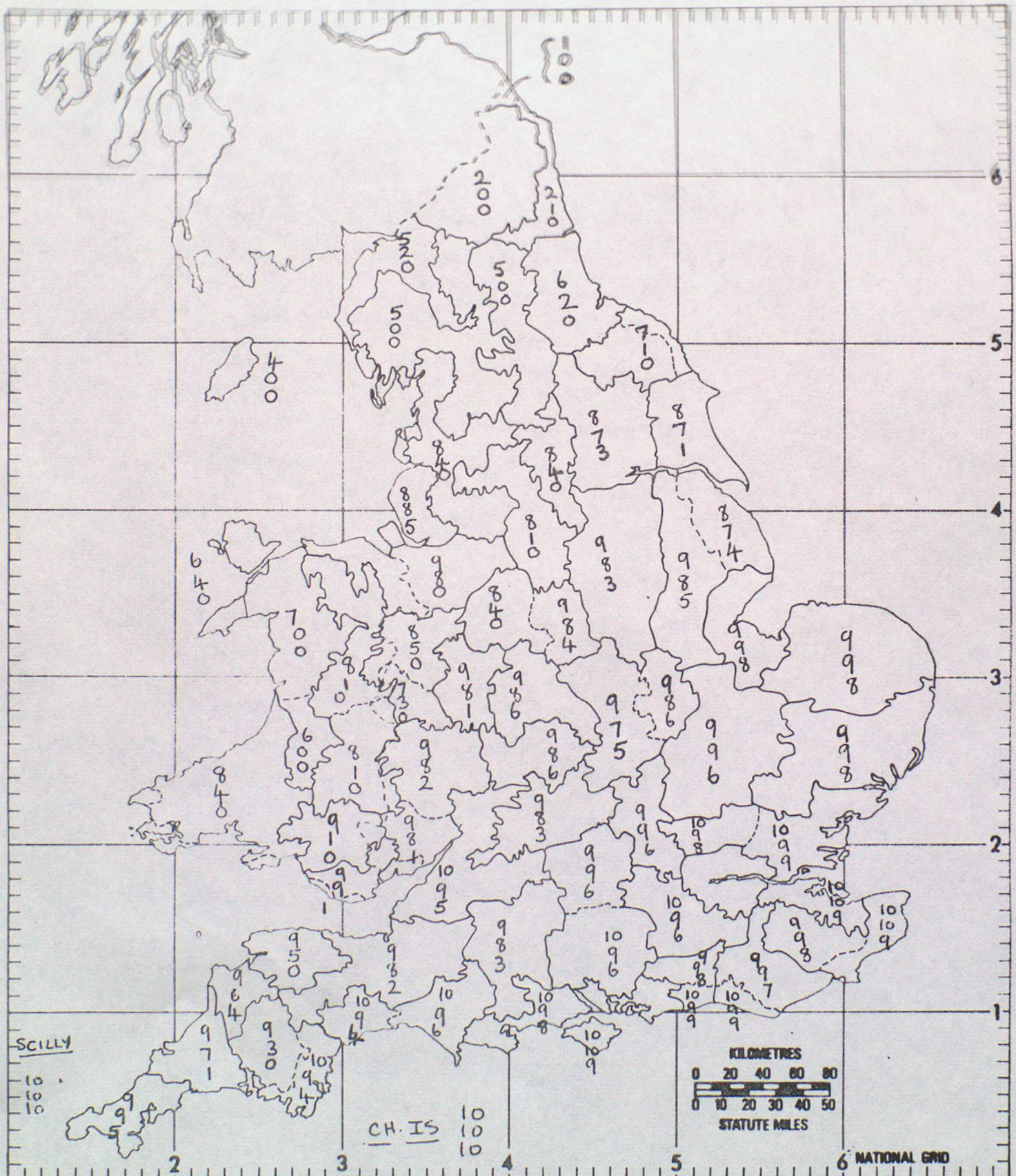
LOW HEIGHT

25000

AVERAGE HEIGHT

HIGH HEIGHT

YEARS IN 10 >>

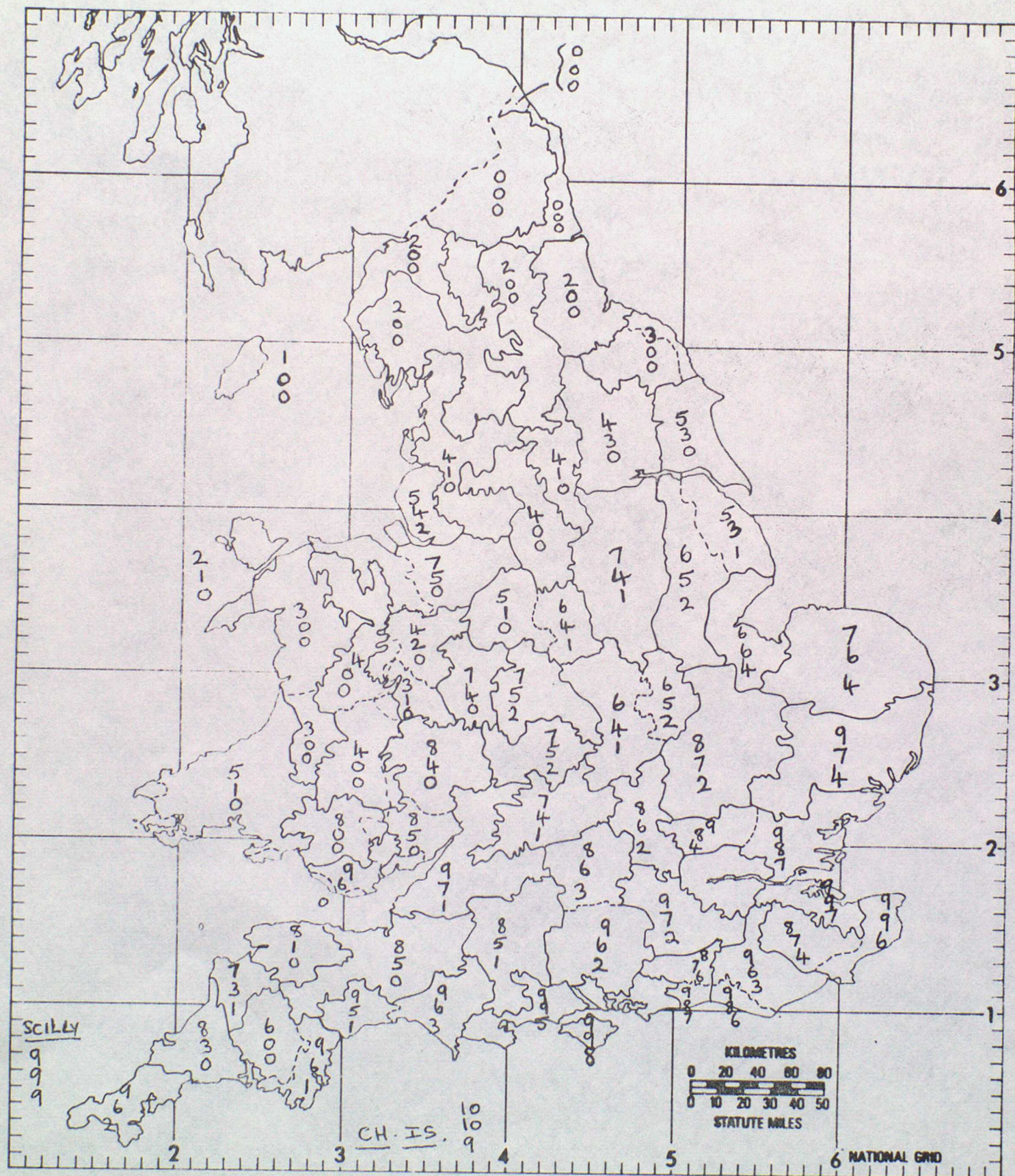


AGROCLIMATIC AREAS FOR ENGLAND AND WALES

LOW HEIGHT
AVERAGE HEIGHT
HIGH HEIGHT.

2700

YEARS IN 10 >



AGROCLIMATIC AREAS FOR ENGLAND AND WALES